**Sign Language Translator for Individuals with Traumatic Brain Injuries**

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**Abstract**

Sign language is a unique form of communication in which hand or other body part gestures are used to express oneself. A large proportion of the world’s population has speech and hearing impairments and communicates through sign language. Sign language, like verbal language, varies from country to country. But for each Sign language there are existing translators or detectors. This project seeks to develop a revolutionary Sign Language Translator, uniquely tailored for individuals who have lost their hearing and speaking abilities due to Traumatic Brain Injuries (TBIs). Conventional sign language translators predominantly cater to established sign languages like ASL and BSL, making them less accessible for TBI survivors. Our proposed solution empowers these individuals by allowing them to create and communicate using their unique set of symbols. The system will feature a sophisticated web interface, enabling users to define personalized signs through a laptop or mobile camera. Furthermore, the system will not only facilitate the labeling of these signs with associated meanings but also generate corresponding sound and text outputs when users perform their defined signs. This endeavor aims to redefine communication accessibility for TBI survivors, fostering independence and self-expression.

**1.0 Introduction**

Sign language (SL) is a distinctive form of communication for hearing and speaking-impaired people that uses hand gestures and non-verbal indicators (such as facial expressions) to convey messages. Based on a survey by the World Federation of the Deaf, there are more than 300 SLs used by 70 million deaf individuals worldwide [1].

Traumatic brain injuries (TBIs) pose a special challenge because they frequently have a significant impact on a person's capacity for efficient language comprehension and articulation. While traditional sign language solutions are admirable for some populations, individuals with TBI-related cognitive impairments may find them to be insurmountable obstacles. With its proposal for a Sign Language Translator designed specifically for TBI survivors, this project presents a paradigm shift. It seeks to enable these people to express themselves through symbols that connect with their individual experiences and expressions by providing a platform that is both customizable and easy to use. By utilizing cutting-edge technology, the project aims to improve the communication skills of people who have traumatic brain injuries (TBIs), promoting a more accepting and compassionate society where all voices—even those that are silent—are heard. This project enables a user to train the model by himself, but we know that SLT requires or relies on large-scale data training. Without it SLT may produce wrong results. Recently, some innovative forms of learning is introduced that can learn from very few training data. Few-shot learning is one of them. Few-Shot Learning is a machine learning sub-field that is concerned about categorizing new data when we just have a few supervised training examples [2].

**2.0 Background and Problem Identification**

Current sign language translators primarily focus on established sign languages, presenting a significant challenge for individuals with TBI. Learning these standardized systems may be impractical for those already facing cognitive and communication impairments. The identified problem lies in the absence of a communication tool that accommodates the unique symbols and expressions that TBI survivors may naturally adopt. This project aims to address this gap by enabling users to define and communicate using their own set of symbols. By fostering a personalized and intuitive communication experience, the proposed Sign Language Translator seeks to mitigate the communication barriers faced by individuals with TBIs, enhancing their overall quality of life and social integration.

**3.0 Proposed Work and its Methodology**

**3.1 Proposed Work**

The primary goal of this project is to develop a Customized Sign Language Translator addressing critical gaps in existing Sign Language Translation (SLT) systems. While current SLT solutions exist, none offer the level of customization allowing users to add their unique hand gestures. Additionally, the proposed solution aims to overcome limitations in existing systems by seamlessly integrating both text and speech inputs, providing a more inclusive communication experience. The project focuses on a systematic development approach, combining a comprehensive narrative review, exploration of existing SLT systems, and a classical SDLC model to ensure a well-structured and customizable solution that meets the specific needs of users. Deliverables include a detailed customization plan, comparative analysis of existing SLT systems, and a finalized Customized Sign Language Translator ready for deployment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Products | Standard | Text and Speech | Gesture Addition | Web Interface |
| SLT by Google Cloud | ASL | 🗶 | 🗶 | 🗶 |
| Hand talk Translator | ASL | 🗶 | 🗶 | 🗶 |
| ASL Translator by Software Studios | ASL | 🗶 | 🗶 | 🗶 |
| Proposed System | User Defined Gestures | ✓ | ✓ | ✓ |

*Table No. 1.1 Differences with Existing Systems*

**3.2 Methodology**

**3.2.1 Innovative Web Interface for Personalized Signs**

* Creation of an interactive web platform accessible via laptop or mobile cameras.
* Seamless definition and personalization of communication signs, tailored for individuals with Traumatic Brain Injuries.
* Reflection of users' unique experiences and expressions in their personalized signs.

**3.2.2 Cutting-edge Few-Shot Learning for User-Friendly Training**

* Integration of Few-Shot Learning to streamline customization processes. [6]
* Empowerment of the model with a minimal 3 to 5 images per gesture for efficient and accessible training.
* Addressing potential cognitive constraints during the learning process for enhanced feasibility.

**3.2.3 Advanced Image Recognition and Processing Methodology**

* Fusion of sophisticated image recognition and processing techniques.
* Capture and analysis of user-defined gestures through the web interface.
* Utilization of Convolutional Neural Networks (CNNs) or similar architectures for accurate identification and classification of intricate gestures.

**3.2.4 Seamless Translation to Text Representation**

* Effortless translation of user-defined signs into textual representation.
* Provision of a visual representation of the communicated message.
* Enhancement of accessibility and communication through a combination of visual and textual outputs.

**3.2.5 Simultaneous Sound Output Generation for Multi-Modal Communication**

* Real-time generation of sound outputs corresponding to user-defined signs.
* Creation of a multi-modal communication experience for a comprehensive and enriched interaction.
* Improved accessibility for both the user and those interacting with them.

**3.2.6 Holistic Approach Ensuring a Comprehensive Communication Experience**

* Comprehensive integration of text and sound outputs with user-centric customization and Few Shot Learning.
* Recognition of diverse needs of TBI survivors, fostering an empowering and personalized communication journey.
* Aiming for a robust, inclusive, and innovative communication experience.

**4. 0 Conclusion(s)**

In conclusion, this project endeavors to provide a groundbreaking solution for individuals with Traumatic Brain Injuries, offering them a customizable Sign Language Translator. The proposed web interface and Few Shot Learning methodology are designed to facilitate user-friendly customization and ease of training. Successful implementation holds the potential to significantly enhance the quality of life for TBI survivors by enabling effective communication in various contexts.

**5. 0 Project Management**

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The Customized Sign Language Translator project initiates with a narrative review, delving into the context and requirements to establish a comprehensive understanding of its scope. Following this, an exploration of existing Sign Language Translation (SLT) systems takes place, analyzing technologies and identifying strengths and weaknesses. Subsequently, specific challenges and opportunities for customization are detected, providing a critical analysis of potential limitations in current systems. With a clear understanding of customization requirements, the project adopts a classical development approach, selecting a suitable Software Development Life Cycle (SDLC) model such as the Waterfall Model for structured progress. The implementation and testing phase ensues, involving iterative coding, integration, and rigorous testing to ensure customized features meet specifications. The project concludes with a finalization phase, encompassing testing, deployment preparation, and documentation, resulting in a well-executed Customized Sign Language Translator aligned with user requirements and poised for use and future enhancements.

**5.1 Workflow Chart**

Login or Sign up

Authorization

Home Page

Video Features

Available

Featuresn up

Gesture Addition

Real-time Transaltion

Video Recording

Video Calling

*Fig-1.2 Work-flow Diagram*

**5.2 Project Break down**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topics** | **Group Member** | |  |
| Background and basic working of existing sign language translators/detectors based (ASL/BSL) | Studied by all Group Members | |  |
|  | *Table No. 1.2 Narrative Review* | |  |
| **Study and Research of Few Shot Learning and OpenCV** | | |  |
| **Few-Shot Learning**   1. Gesture Classification   2) Algorithms:-  -Prototypical Networks  -Matching Networks  -MAML  -Reptile  -CNPs | Amjad Ali (191-21-0001)  Muhammad Ahsan (021-21-0016) | |  |
| **OpenCV**  -Gesture Recognition  -Feature Extraction  -Text or Speech Synthesis | Abdul Sattar (021-21-0080) | |  |
|  | *Table No. 1.3 Topic Distribution* | |  |
| **Site Visits and Research** | | |  |
| <https://github.com/SufiyaanNadeem/Sign-Language-Translator> | This has been done by all the group members collectively. | |  |
| Research Papers |  |
| https://www.v7labs.com/blog/few-shot-learning-guide |  |
|  | | | |
| **Existing Products** | | | |
| Real Time Sign Language Translator by Google Cloud [3] | | | |
| Hand Talk Sign Language Translator by Hand Talk [4] | | | |
| ASL Translator by Software Studio LLC [5] | | | |
| *Table No. 1.5 Existing Systems* | | | |
| **Design & Implementation** | | | |
| Frontend Design | | Muhammad Ahsan (021-21-0016) | |
| Backend Design | | Amjad Ali (191-21-0001) | |
| Integration and Documentation | | Abdul Sattar (021-21-0080) | |
| Gesture Recognition and Meta Learning Algorithm’s Implementation | | Collectively | |
|  | | *Table No. 1.6 Work Division* | |

**5.3 Tools Required**

* **Programming Languages:** Python will be employed for backend development, while HTML, CSS, and JavaScript will be utilized for crafting the web interface.
* **Frameworks:** We can use meta learning algorithms like MAML (Model-Agnostic Meta-Learning) and Reptile to implement Few-shot learning. Moreover, Architectures like NTMs (Neural Turing Machines) can store information about few-shot examples and generalize to new examples.
* **Web Development Tools:** Backend development may use Django or Flask, and frontend development will be facilitated by React or Angular.
* **Database:** Storing user-defined signs and associated meanings will be managed using MongoDB or MySQL.

**5.4 Project Feasibility:**

The feasibility of our project is contingent upon several critical considerations. Firstly, the accessibility and affordability of the tools and technologies utilized must align with the capabilities and resources of our target users, including Traumatic Brain Injury (TBI) survivors. Collaborating closely with TBI survivors is integral to understanding their unique communication needs, ensuring the project is designed with inclusivity and user-centricity. The adoption of Few-shot Learning plays a pivotal role by reducing the amount of training data required, making the customization process more manageable for individuals, especially those with cognitive impairments resulting from TBI. Furthermore, comprehensive user training programs and ongoing support mechanisms are essential components to enhance usability and navigate potential challenges effectively. By addressing these factors collectively, we aim to create a Sign Language Translator that is not only technically sound but also practical, accessible, and truly impactful for individuals with Traumatic Brain Injuries.

**6.0 Reference(s)**

1. World Federation of the Deaf. <https://wfdeaf.org/> Accessed 11-02-2024.
2. [Generalizing from a Few Examples: A Survey on Few-shot Learning: ACM Computing Surveys: Vol 53, No 3](https://dl.acm.org/doi/10.1145/3386252) Accessed 12-02-2024.
3. <https://www.googlecloudcommunity.com/gc/AI-ML/REAL-TIME-SIGN-LANGUAGE-TRANSLATOR/m-p/667694>
4. <https://www.handtalk.me/en/blog/meet-the-hand-talk-sign-language-translator-app/>
5. <https://apps.apple.com/us/app/asl-translator/id421784745?correlationId=0391f79d-1f08-4cf2-a920-f6ccf240e7b0>
6. <https://www.v7labs.com/blog/few-shot-learning-guide>